

# Claims

[c1] What is claimed is:

1. A receiver comprising:

a tuner for down-converting an incoming signal to produce a down-converted signal according to a local oscillator signal corresponding to a selected channel;

a filter coupled to the tuner for filtering the down-converted signal to produce an intermediate frequency (IF) signal;

a carrier recovery unit coupled to the filter for locking to a carrier frequency of the IF signal; and

a pre-shift unit coupled to the tuner for shifting the local oscillator signal in a first direction by a predetermined first frequency shift in a first phase of carrier recovery, and then for shifting the local oscillator signal in a second direction by a second frequency shift in a second phase of carrier recovery.

[c2] 2. The receiver of claim 1, wherein the first direction is an increase in frequency and the second direction is a decrease in frequency.

[c3] 3. The receiver of claim 1, wherein the filter is a surface acoustic wave (SAW) filter.

[c4] 4. The receiver of claim 1, further comprising:  
a lock detector coupled to the carrier recovery unit and  
the pre-shift unit for determining whether or not the  
carrier recovery unit has locked to the carrier of the IF  
signal;  
wherein the pre-shift unit transitions from the first  
phase to the second phase of carrier recovery after the  
lock detector determines the carrier recovery unit has  
locked to the carrier of the IF signal.

[c5] 5. The receiver of claim 4, wherein the pre-shift unit  
transitions from the second phase to the first phase of  
carrier recovery if the lock detector does not within a  
predetermined time period determine that the carrier re-  
covery unit has locked to the carrier of the IF signal.

[c6] 6. The receiver of claim 4, wherein the carrier recovery  
unit has a phase locked loop (PLL) structure comprising a  
voltage controlled oscillator (VCO);  
wherein the second frequency shift is the difference be-  
tween a predetermined center frequency of the VCO and  
a locked frequency of the VCO in the first phase of car-  
rier recovery when the lock detector determines the car-  
rier recovery unit has locked to the carrier of the IF sig-  
nal.

- [c7] 7. The receiver of claim 6, wherein the pre-shift unit shifts the VCO in the second direction by a predetermined third frequency shift in the first phase of carrier recovery, and then shifts the VCO in the first direction by a fourth frequency shift in the second phase of carrier recovery.
- [c8] 8. The receiver of claim 7, wherein the predetermined third frequency shift is substantially zero, and the fourth frequency shift is substantially equal to the second frequency shift.
- [c9] 9. The receiver of claim 1, wherein during the second phase of carrier recovery, the pre-shift unit shifts the local oscillator signal in the second direction by the second frequency shift to position a pilot tone of the selected channel at a lower edge of an in-band range of the filter.
- [c10] 10. The receiver of claim 1, wherein the receiver is an Advanced Television Systems Committee (ATSC) digital television (DTV) receiver.
- [c11] 11. A method of recovering an incoming signal, the method comprising:  
down-converting the incoming signal to produce an down-converted signal according to a local oscillator signal corresponding to a selected channel;

filtering the down-converted signal to produce an intermediate frequency (IF) signal; in a first phase of carrier recovery, shifting the local oscillator signal in a first direction by a predetermined first frequency shift; locking to a carrier frequency of the IF signal; and in a second phase of carrier recovery, shifting the local oscillator signal in a second direction by a second frequency shift.

- [c12] 12. The method of claim 11, wherein the first direction is an increase in frequency and the second direction is a decrease in frequency.
- [c13] 13. The method of claim 11, further comprising:
  - determining whether or not the carrier of the IF signal has been locked; and
  - transitioning from the first phase to the second phase of carrier recovery after the carrier of the IF signal has been locked.
- [c14] 14. The method of claim 13, further comprising transitioning from the second phase to the first phase of carrier recovery if the carrier of the IF signal has not been locked within a predetermined time period.
- [c15] 15. The method of claim 11, wherein the second fre-

quency shift is the difference between a predetermined center frequency and a locked frequency in the first phase of carrier recovery when the carrier of the IF signal has been locked.

- [c16] 16.The method of claim 11, wherein during the second phase of carrier recovery, shifting the local oscillator signal in the second direction by the second frequency shift positions a pilot tone of the selected channel at a lower edge of an in-band range of the filter.
- [c17] 17.The method of claim 11, wherein the incoming signal is an Advanced Television Systems Committee (ATSC) digital television (DTV) signal.